Physics 491/493 & 492/494
Senior Thesis Research/Seminar
Introductory Lecture - Outline

Fall 2016 - Spring 2017

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Hermann Brown 229

- Course Objectives
- Course Learning Outcomes
- Purposes of Course
- Methods Used
- Grades
- Preparation of Papers and Presentations
- Peer Reviews
- Research Logbook
- Professional Attitudes
- Summary
- Schedules and Deadlines
- Prospectus
- Peer Review Preparation

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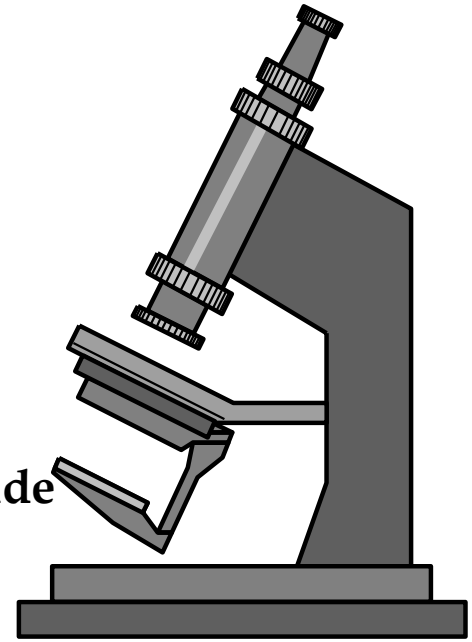
P491/3: Course Objectives

1. Learn from first hand experience how scientific research is done. Go through every step, from the proposal of a project to the publication of the result.
2. Learn how to present proposed research so that peers and funding officers are convinced it its value, and thus approve and fund the work.
3. Learn how to present progress reports so that your advisors, your teacher, and your peers are convinced that you are making sufficient progress towards completion of your project and of your senior thesis by the end of the academic year.
4. Learn how to write a thesis which is defensible to your advisors, your teacher, and your peers.
5. Defend this thesis at the close of the academic year.

P491/3: Learning Outcomes

1. **You will decide whether to pursue graduate studies in some field of physics or engineering.**
2. **You will learn how to write and defend a thesis, which will help you get started on your M.A. and Ph.D. theses (if you choose to go to graduate school).**
3. **You will be better prepared for job interviews if you do not choose to go to graduate school.**

P491/3: Purposes



- **Learn about Research**
  - What's so different about Research?
    - Distinct from known science
    - GOAL: add to knowledge base
  - Essential to acquire *inquisitive* & *skeptical* attitude
  - Begin to learn good habits and techniques
- **Adopt a Professional Attitude**
  - Learn to think as a scientist – different from thinking as a student
    - (A Professional is one who does his/her job even when he/she doesn't feel like it. W. James)
  - Practice and learn importance of:
    - Writing scientific reports
    - Presenting oral reports
    - Peer reviewing
    - Personal scientific honesty

P491/3: Methods I

- YOU choose a research advisor. Must be a physics topic. "Sell" yourself to the advisor (don't be bashful).
- YOU must meet with your advisor regularly - at least once a week - so choose wisely.

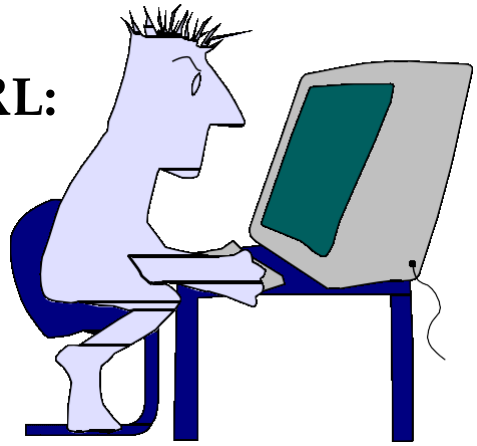
- Submit a 2-page research proposal to my mailbox Room HB229 signed by your advisor & you. If approved, I will sign it and this represents the "contract" between the three of us. Research Proposals always have a title that succinctly describes the project.

- Email each Monday (Tuesday if Monday is a holiday) a *progress report* to me with a copy to advisor.
- First one due next class. Tell me of your progress in finding an advisor.

P491/3: Methods II

- Present oral reports on the progress of your research. You invite & remind your advisor when you speak.
- Class meetings patterned after American Physical Society meetings. Chair (that's me) will time talks & lead discussion.
- Make single–blind Peer Reviews of presentations by an assigned peer. Email to me within a week.
- Course information on schedules, document preparation, this lecture, etc. is at the following URL:

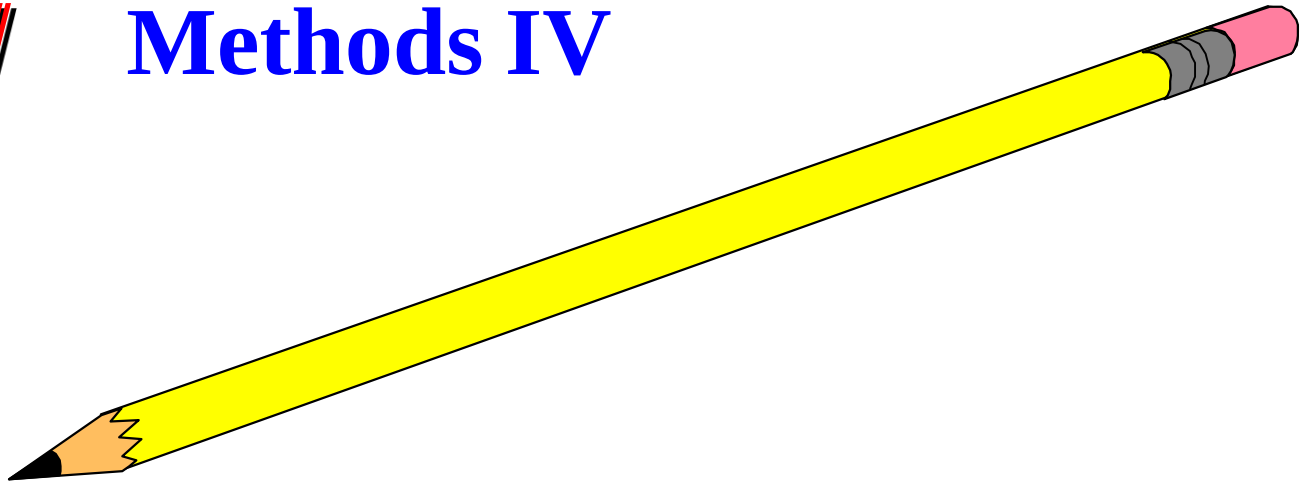
http://www.roberts@physics.rice.edu/roberts/P491/



P491/3: Methods III

- **You will be in email contact with me regularly with three types of email.**
- **Send email to: roberts@physics.rice.edu** *[spaces DO matter in the following:]*
- **For weekly progress report, put in SUBJECT FIELD:**
  - **P491 Progress Report**
- **For Peer Review, put in SUBJECT FIELD:**
  - **P491 Peer Review**
- **For questions, comments, etc. put in SUBJECT FIELD:**
  - **P491 Info**

Methods IV



- **Term Papers**
  - First Semester: Four page summary of project status
  - Second Semester: A thesis is due last day of classes
  - First draft due 2 weeks earlier
  - Each must be prepared in the style of Physical Review
  - Copies of each to me & to the Advisor
- **Date everything you submit to me:**
  - Progress reports and Peer Reviews auto-dated (email)
  - Date logbook entries, papers and abstracts, ...

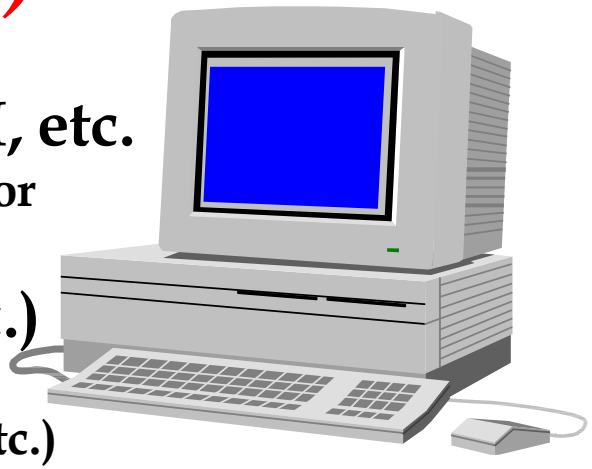
In Other Words:

In this class,
You will begin to learn
to do what scientists do.

- **And just what is that? Besides RESEARCH, I mean?**

- **This class realistically models many of the activities that scientists perform regularly - a subset of the following "dirty dozen."**

What Scientists Do (I)



- 1. Write Proposals (to DOE, NSF, NIH, etc.
  - (for money, equipment, beam time, approval for experiments, etc.)
- 2. Write Progress Reports (to DOE, etc.)
  - (to the folks that gave you the money or the equipment or those who approved the expts, etc.)
- 3. Write Scientific Papers (for PRL, etc.)
  - (explain the motivation, techniques, results, and significance to your peers)
- 4. Write Letters of Recommendation
  - (for colleagues, postdocs, employees, secretaries, faculty up for promotion at your own institution or others, students applying to grad school - hey, this is meant to be only a partial list.)

What Scientists Do (II)

- **5. Write Referee Reports**
  - **(you will be asked to referee manuscripts submitted to scientific journals, proposals sent to funding agencies, etc.)**
- **6. Write & Read Letters, Email, Memos, ...**
  - **(to/from faculty, your collaborators around the world, staff, students, deans, provosts, presidents, congresspersons, etc. about almost all conceivable topics)**
- **7. Teach Students**
  - **(this takes more time than I have space for here)**

What Scientists Do (III)

- 8. Give Presentations
  - (on your research results at conferences and seminars, proposals and progress reports to program committees, review committees, advisory committees, funding agencies, collaborators, etc.)

- 9. Evaluate Applications & Interview Applicants
  - (Grad school, new post docs, faculty, staff members, secretaries, etc.)
- 10. Attend Presentations
  - (to learn and evaluate information provided by others at scientific gatherings - see #8 above)
- 11. Read the relevant literature in your field and beyond

What Scientists Do (IV)

And Finally

- **12. Plan and do your research**
  - **(whether it be experimental or theoretical)**

As you can see, a lot of writing and speaking - and that's true whether you become a scientist or not.

Effectiveness in presenting your ideas is a crucial skill for success.

This course will help you *decide* if graduate school is for you. If yes, advisor's evaluation of your research skills is very important.

GRADES

- **Most important component: progress you make towards development as a professional scientist. Two aspects.**
  - **1. Success at research (P491 & 2)**
  - **2. Progress in peer reviewing & contributing to discussions (P493 & 4)**
- **Your success at research is determined from oral and written reports on your research project. Judged by:**
  - **your research advisor, who will also provide a grade for your performance in the lab or on your theoretical work. Especially for P492.**
  - **your peers, in their reviews and questions about your work.**

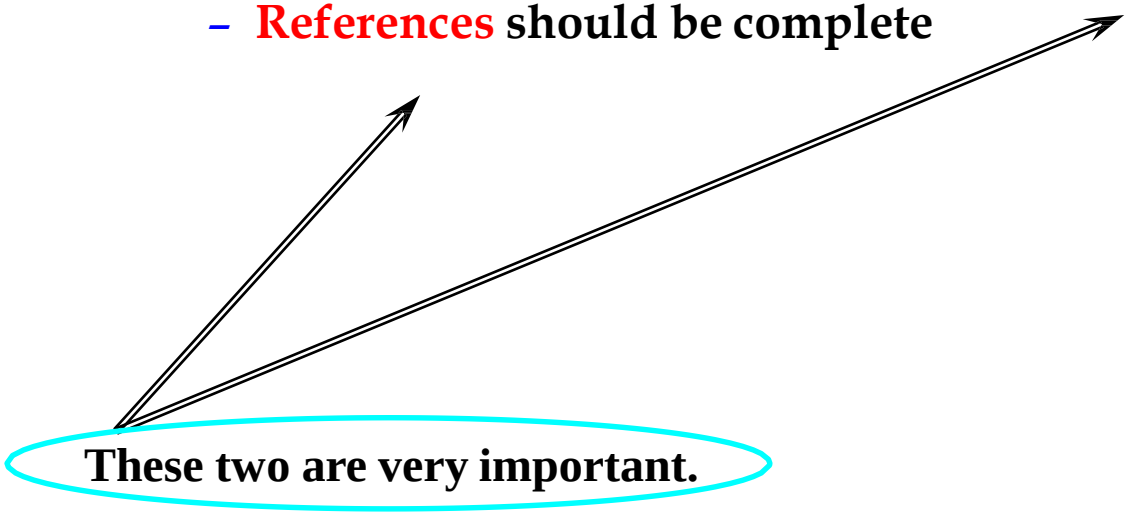
    [n. b. Keep in mind that the reviews are written by your peers. They are learning to write a critical review. You, while reading their review, are learning to evaluate constructive criticism. Both skills are important.]
  - **me. Your presentations, weekly progress reports, peer reviews, term paper and thesis will all be evaluated to determine #1.**
- **Your progress on #2 will be judged by me.**

Good Papers and Presentations

- **Have: a beginning, a middle, and an end**
  - **The beginning contains:**
    - » **a statement of contents**
    - » **the purpose / goals of your work**
    - » **the relationship of your work to what has been done before**
  - **The middle contains:**
    - » **the technical part: how the experiment or calculation is done with references to related work**
    - » **the results of the work, with comparison to other results**
    - » **the conclusions from the work**
  - **The end contains:**
    - » **a summary of the conclusions**
    - » **a description of how the conclusions relate to prior knowledge**

Good Papers and Presentations (II)

- **Tie your project and results to previous research.**
  - **An essential component of scholarship**
  - **Entails referencing previous work that is relevant**
  - **References should be complete**



Preparing Good Papers&Talks

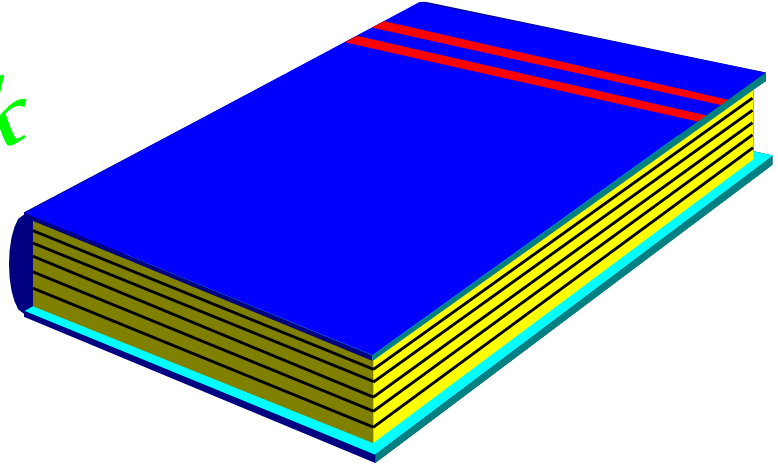
- **Make an outline and revise**
  - **Helps you organize information in a logical order**
- **Good prose**
  - **Clear, concise and to the point**
- **Good Figures / Visual Materials**
  - **Overheads should be well thought out and prepared**
  - **Color can be effective**
  - **PowerPoint presentations encouraged. Your .ppt file can be emailed to me by NOON of the talk day or brought to class on a (previously tested) cd or USB memory stick. Transparencies and chalk OK.**
- **Revise Papers - get colleagues to criticize**
- **Practice presentations on your colleagues**
- **Accept constructive criticisms**

Cannot over-emphasize the importance of this.

Peer Reviews

- **Do them with positive outlook (help, don't decimate)**
- **Scientists are obliged to provide honest & thoughtful appraisal of the work of peers**
- **Contributes to advancing science**
- **Aids other scientists**
- **Perform with a critical, show–me attitude**
- **Trivial results waste time & money**
- **Wrong results even worse**
- **Your reputation is on the line when you do a peer review**
  - **You must understand significance & context of project being reviewed**
- **Use passive voice in general - active voice for emphasis ok**
- **Graded sat/unsatisfactory. Email notification if the latter.**

Research Logbook



- **Essential to record all measurements, calculations, facts, ideas, etc., immediately**
  - **If you fail to observe this, you will lose information**
- **Date each entry - this can be crucial**
- **When other media employed (computer files, discs, printouts, etc.), note existence, contents, & date in your logbook**
- **"No one ever kept too complete a logbook"**

Professional Attitudes

- **Dedication to Profession**
- **Dedication to Science**
- **Acceptance of duty to help others**
- **Skeptical attitude – doubt *all* results and explanations**
- **Recognition that the honor of a scientist is invaluable**

SUMMARY

- **Purposes of this course**
  - **Engage in research to advance knowledge**
  - **Engage in activities as a professional scientist - not just as a student**
- **Methods used in this course**
  - **Do research**
  - **Give oral presentations on your research**
  - **Write proposal, progress reports, and scientific papers**
  - **Perform, write, interpret, and evaluate peer reviews**

Schedules & Deadlines

- **Fall Semester 2016**
  - 1st Class — 3 pm — Mon, Aug.22
  - 1st Weekly Progress Report
  - Proposal Due (my mailbox) — 3 pm — Mon, Sept.26
  - 1st Round of Talks Begins — 3 pm — Mon, Sept. 26
  - Semester Final Report — 5 pm — Fri, Dec. 2

- **Spring Semester 2017**
  - Outline of Thesis — Mid April
  - Thesis& Final Presentation — Monday, April 24

Prospectus - 1

From:roberts@physics.rice.edu

http://www.roberts@physics.rice.edu/roberts/P491/

PHYSICS 491/493

Senior Thesis Research. See Previous Page for Deadlines.

Prospectus, Instructions, & Peer Review Preparation

This course will be different in many ways from any course that you have taken at Rice. The first difference is that you will be expected to read, understand, and have available for future use the following information. Excuses such as, "I didn't know we had to ..." are not acceptable. You will meet deadlines in a professional manner. These instructions, along with the information presented in my initial lecture (part of this PPT file), will tell you what is expected of you.

- **0. Most of the correspondence between you and me will be by email. Send me a test message which will provide me your address. I will post schedules, instructions, even this info, on the class webpage at the URL above.**
- **1. During the first two weeks of classes you will choose an advisor and a *physics* research topic. You will convince an approved professor that you are willing, able, and eager to work with him or her on a thesis project. Then you will write a Research Proposal. The proposal must have a title that succinctly describes the work being undertaken.**
- **2. By deadline given above, you will submit a Research Proposal to me. This will consist of at least two pages (hard copy, neatly prepared) detailing your understanding of your senior research project. A succinct Title is required. This statement must be approved and signed by your faculty research advisor and by you with a copy to me and to your advisor. When I approve the proposal, it then becomes a "contract" between the three of us. You will be notified of my decision via email later that day.**
- **3. In the first semester, background reading should be done early and conscientiously. In parallel with this, you must make a dynamic start on your project, either in the laboratory or on theoretical work, as appropriate. Regular meetings with your advisor, at least once a week, are essential for success. *You are the one responsible for arranging such meetings.***

Prospectus - 2

4. A bound research notebook/diary should be started immediately (today). In it you will keep a detailed log of your work on the project. This logbook will be examined by me at the end of the first semester and will comprise an important part of your grade for that semester.

5. The class will meet as a group according to the schedule I will distribute by email and on the web later. During the first semester, each student will be scheduled to give two fifteen-minute presentations. The first one will contain the background, purpose, theory, etc. of the project. The second one will be more of a progress report on the project, but will still be a self-contained talk.

   One important objective of the course is to teach you to *present* your ideas and the results of your work in an effective manner. In order for this to occur, you must prepare your talk and practice its delivery beforehand. A fifteen minute presentation lasts (surprise) 15 minutes. Not ten minutes and not sixteen minutes. The moderator is strict about going over your allotted time, and to not use your full allotment causes the printed schedule to go awry.

   Your faculty research advisor will be notified by email when you are scheduled to speak. You will personally invite him or her to attend your presentation. All class members will attend all presentations.

   After each presentation, there will be a 5-minute question and answer period. You must understand your classmates' projects from the information that they present in their talks. Toward that end, you will ask questions to clarify the purpose, the techniques being used, where the project fits with respect to the rest of science, etc. Your participation in asking questions will also form the basis for part of your grade in the course.

6. I will assign your duties as a "peer reviewer" of presentations made by two fellow class members. You will write a review of each presentation made by your speakers. Send me an email critiquing those talks within one week of the presentation. I will read your reviews in a timely fashion and notify you if one is unsatisfactory. The grading will be Satisfactory/Unsatisfactory on the Peer Reviews, but this too will be a factor in your overall grade. I will also email an unedited, anonymized copy, with my comments (if any) to the student being reviewed. *Read and follow the suggestions on how to write a peer review given below*.

Prospectus - 3

7. **Each Monday (Tuesday when Monday is a holiday) you will email me a one-page progress report, summarizing your work on the project during the preceding week. If for some inconceivable reason you have done no work, email a report so stating. The first such summary is due next Monday. These are informal reports, in much the same spirit and style as the information in your research notebook. In fact, if you keep your logbook properly then this will be a very easy task.**

8. **Your research notebook is due in my box by noon on the last day of first semester classes. Also due is a four page typewritten paper detailing the background and present status of your project. This is a practice exercise for the thesis you will write during the second semester. The format will be very similar, and I will post on the web detailed instructions on what is expected. Your *first semester grade* will be based on all the elements mentioned above: *the final paper, your notebook, your class presentations, the peer reviews you submit, your weekly progress reports, and your participation in the question/answer sessions, as well as any input your advisor wishes to provide.***

9. **Your thesis at the end of the second semester will document the background, purpose, theory, methods, results, interpretation, and significance of your research. We will go over the style, format, and content in more detail as the time approaches. A first draft of the thesis will be due in my box, with a copy to your advisor, two weeks before the end of second semester classes. The final draft is due in my box on the last day of second semester classes. The paper should be prepared in the style of Physical Review, be typewritten, and exemplify good grammar and spelling. A copy of this thesis must be submitted to your research advisor, who will grade it and provide me with a grade based on his or her assessment of your progress in research. Those grades, together with the one I assign based on your class participation, presentations, progress reports, peer reviews, and thesis will determine your second semester grade.**

10. **On the Monday of reading period, we will have an all-day conference in which everyone will present the results of their project. This conference is known as the Rice University Mini–Physical Society Meeting (RUMPS). A Bulletin of the meeting, containing abstracts of the presentations that you will provide to me, will be published and distributed locally in the week preceding the meeting. Examples of previous years' Bulletins will also be available on our homepage.**

Peer Review Preparation

How to prepare a good Peer Review Report

*E-mail Peer Review Reports to me at the following address: roberts@physics.***rice.edu** **with this identifier in the subject field: P491 Peer Review**

They should be at least one page long and sent within one week after the presentation. I will forward an anonymized, unedited copy to the person being reviewed. I may also add a note to that copy with my own observations regarding the presentation being reviewed. When you receive your copy of a classmate's peer review of your talk, please read the review with an open mind, realizing that the contents represent the opinions of a peer, not the informed judgment of a professional scientist. You may learn something from it, but use your common sense and do not slavishly follow the recommendations . Part of your training is to learn to evaluate such a review.

In preparing a peer review, you should comment on how the speaker performed and make constructive suggestions based on the following partial list of considerations. You are not writing the report to the speaker. You are reporting to a general audience both the content and your critique of the presentation and the project itself, much as you would write a review of a book or concert. Therefore, you should use the passive voice in general.

1. **Introduction. First briefly identify the presentation you are reviewing. Summarize what the talk was about, mentioning the goals, methods, progress, conclusions, and future plans that were presented. This part of your review is an objective report on the content of the talk. Demonstrate to the reader that you attended and were paying attention to the presentation.**
2. **Organization of the presentation. You should comment on whether the presentation was well organized and logical. Were the assumptions, definitions, methods, goals, and results clearly stated? Had the speaker spent the time and effort required to organize the talk. Did the speaker finish on time after having presented all the material in an orderly fashion?**
3. **Scholarship. Did the speaker attempt to put the work being reported in context? Did he or she cite previous work (references to the literature) adequately? Did he or she make clear just what is new or different about his or her work?**
4. **Oratorical skills. Did the speaker expound with complete sentences, free of halting pauses and/or monosyllabic connectives such as "...uh...," or, surely not "...you know?" Was the speaker knowledgeable, confident, and interested in the project? Did you feel that you were personally being addressed because of good use of eye contact by the speaker?**
5. **Visual aids. If the speaker chose to use PPT or transparencies, were they neat, legible, & well prepared? Did the speaker attempt to put too much information on each slide? Did they really help to accomplish the objective of getting the speaker's message across to you?**
6. **Your judgment of the research. Is the research timely and interesting? Are the approaches being used (or contemplated) likely to succeed? Give your reaction to the research project and the results that were presented.**
7. **The bottom line. If you were a potential employer, what would be your reaction? Suppose you were an editor at the Physical Review, would you recommend publication of the research being reported? If you were an administrator at NSF or DOE being asked to fund this research, what would be your response?**